BiLateral Operational Storm-Scale Observation and Modeling (BLOSSOM)

-Early Formulation-

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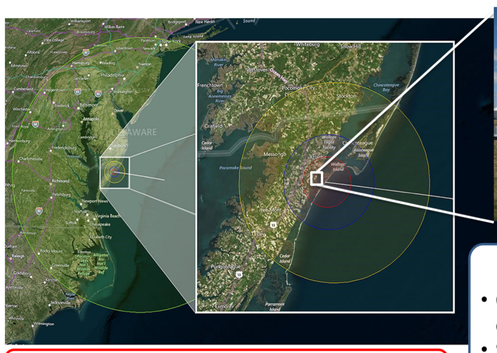
GOALS

1. *Establish a long-term super site to improve understanding of physical processes of cloud-convection and precipitation (CCP) and to support satellite missions.*
2. *Provide meteorological large-scale forcing input to drive different CRMs, large-eddy simulation (LES) models, and single-column models (SCMs) for improvement of CCP parameterizations.*
3. *Provide routine storm-scale GCE simulations to bridge remote sensing observations and CCP processes (shallow-deep precipitating convection).*
4. *Bundle ground-based observations, process modeling, and NASA satellite data over the WFF site to generate value-added BLOSSOM Bundled Data.*

NASA Wallop Flight Facility (WFF)



World-Class CCP instruments
- **Radar**: NPOL, D3R, MRR
- **In-situ**: 2DVD/Parsivel/PIP, Gauge, All-in-One
- **Satellites**: GPM, GOES-R, Terra/Aqua/Suomi
- **Trailers (TBD)**: SMART, COMMIT, and ACHIEVE

Precipitation Systems
- Continental and maritime organized convection
- Sea-breeze-driven convection
- Mid-latitude frontal systems
- Winter-time nor'easters
- Tropical cyclones

- NASA WFF has many world-class CCP instruments used to validate precipitation retrievals of the GPM core satellite.
- WFF instruments has been relocated time-to-time during NASA's GPM Ground Validation (GV) field campaigns (no more planned GPM field campaign).
- WFF site should **support validation and improvement of LES/CRM/SCM** and synergistic usage between remote sensing and numerical modeling to better understand CCP processes.

Large-Scale Forcing

- Long-term large-scale forcing will be generated over WFF for supporting diverse modeling community (LES, CRM, SCM).
- VARiational ANAlysis (VARNAL) approach [Zhang and Lin 1997, Zhang et al. 2001, Xie et al. 2004] will be implemented to constrain atmospheric states from reanalysis products by MRMS surface rainfall rate and CERES energy budgets data.
- Create ensemble large-scale forcing from different renalaysis products, MERRA2, ER-5, CFSR, JRA-25

Potential Temperature tendency:

$$\frac{\partial \theta_m}{\partial t} = \left(\frac{\partial \theta_m}{\partial t}\right)_{\text{phy}} - (\mathbf{V}\cdot\nabla\theta)_{\text{LS}} - \omega_{\text{LS}}\frac{\partial \theta_m}{\partial p}$$

Moisture tendency:

$$\frac{\partial q_m}{\partial t} = \left(\frac{\partial q_m}{\partial t}\right)_{\text{phy}} - (\mathbf{V}\cdot\nabla q)_{\text{LS}} - \omega_{\text{LS}}\frac{\partial q_m}{\partial p}$$

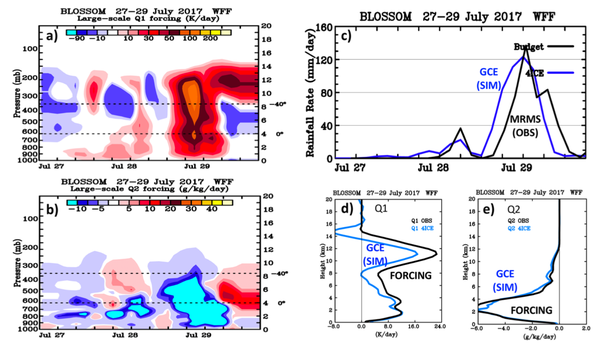
Model Physics | Large-Scale Forcing

From Zhang et al. 2001

Preliminary Results

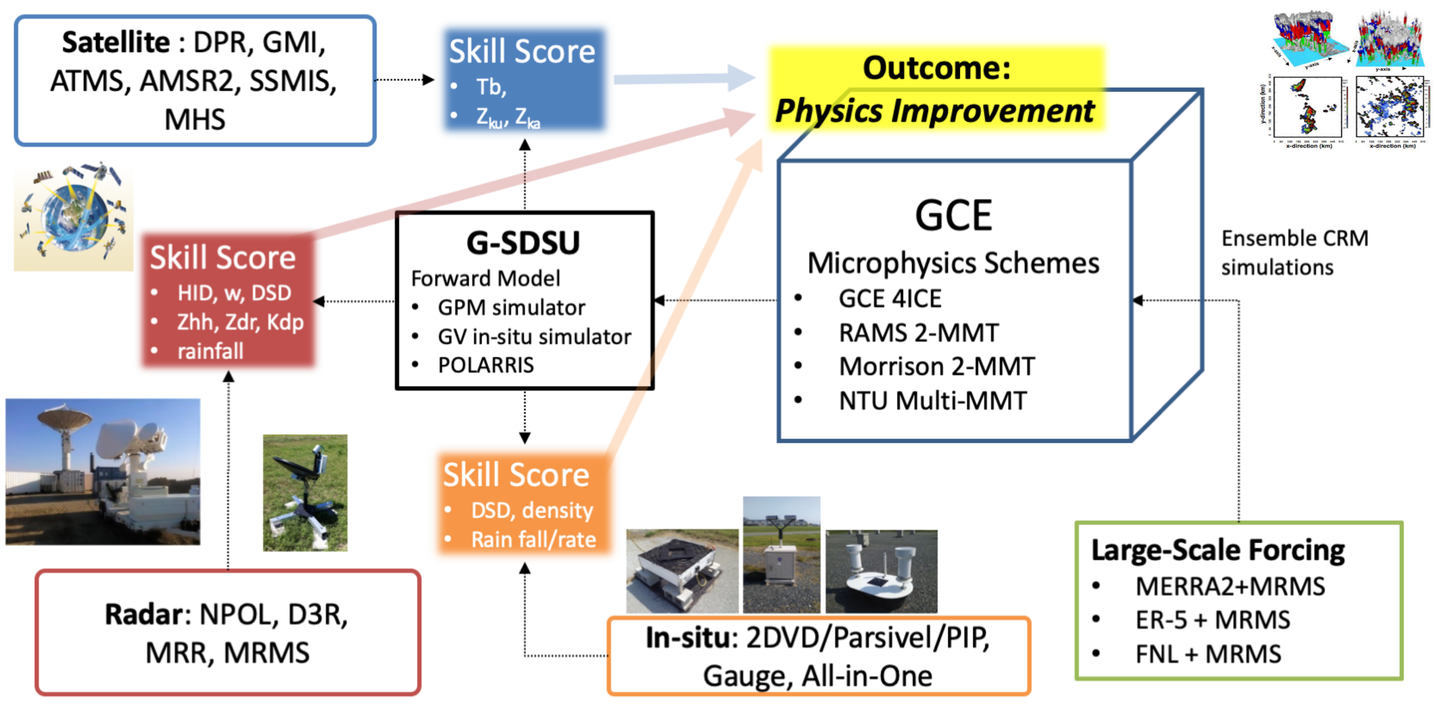
-BLOSSOM Large Scale Forcing-

MERRA2+MRMS rain+CERES ebudget



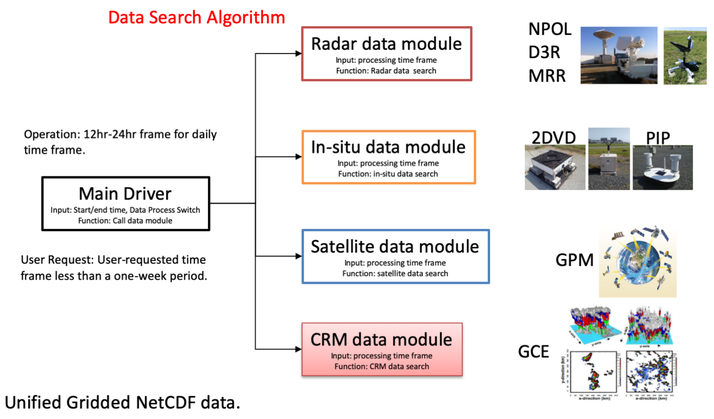
MERRA2-based large-scale forcing of a) Q1 and b) Q2 budget profiles from VARNAL. c) Time series of surface rainfall generated by Goddard Cumulus Ensemble (GCE) simulations and observed by the MRMS rainfall data. Time integrated d) Q1 and e) Q2 profiles from the GCE simulation and large-scale forcing.

BLOSSOM Flow Chart For Model Improvement



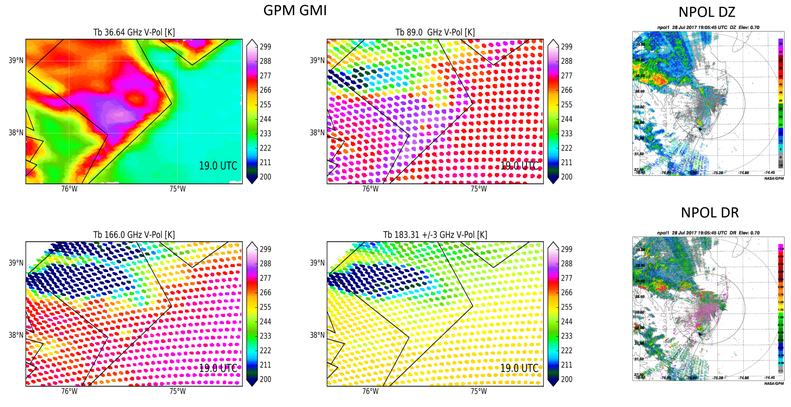
BLOSSOM Data Processing System

-Main Driver-



GPM L1D product

- GPM L1C (cross-calibrated Tb) is re-gridded (0.01deg) for the WFF domain.
- Gridded satellite product can be readily compared with gridded radar data.



APPLICATION

1. *Validate operational satellite product and design future satellite mission.*
2. *Elucidate unobservable cloud processes and properties to develop more sophisticated algorithm.*
3. *Evaluate higher-order microphysics parameterization and CCP processes of process models (CRM+LES).*
4. *Evaluate and develop convective parameterization of climate models (SCM).*

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